UHD World Association
世界超高清视频产业联盟

Measuring method of the public display system (outdoor) of UHD video and audio broadcasting system for “Bai Cheng Qian Ping”

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Measuring method of the public display system (outdoor) of UHD video and audio broadcasting system for “Bai Cheng Qian Ping”

1 Scope

This document specifies the test method of outdoor UHD LED display system (hereinafter referred to as the display system) of the UHD video and audio transmission system for "Bai Cheng Qian Ping".
This document is applicable to the testing and certification of the outdoor UHD LED public display system of the UHD video and audio transmission system for "Bai Cheng Qian Ping".

2 Normative References

The contents in the following documents, through normative references in the text, constitute indispensable provisions of this document. Among them, the dated reference documents are only applicable to the version corresponding to that date; For undated references, the latest version (including all amendments) is applicable to this document.
GB 17625.1 Electromagnetic Compatibility Limits Harmonic Current Emission Limits (Input current of each phase of equipment ≤ 16A)
GB 20943 Single Output AC DC and AC AC External Power Supply Limited Value of Energy Efficiency and Evaluation Value of Energy Conservation
GB/T 4208 Degrees of Protection Provided by Enclosures (IP Code)
GB/T 9254.2 Information Technology Equipment, Multimedia Equipment and Receivers Electromagnetic Compatibility Part 2: Immunity Requirements
GB/T 14714-2008 General Specification for Switching Power Supply for Micro computer System Equipment
GB/T 26125 Determination of Six Restricted Substances (Lead, Mercury, Cadmium, Hexavalent Chromium, Polybrominated Biphenyls and Polybrominated Diphenyl Ethers) in Electronic and Electrical Products
GB/T 26270-2010 Standard Test Signals for Digital Television Receiving Equipment
GB/T 34973 Field Test Method for Interference Light of LED Display
GB/T 41808—2022 Image parameter values for high dynamic range television for use in production and programme exchange (ITU-R BT.2100-2:2018)
GY/T 307-2017 Program production and exchange parameter values of UHDTV system
GY/T 330-2020 Ultra HD High Dynamic Range Video System Color Bar Test Chart
SJ/T 11141 General Specification for Light Emitting Diode (LED) Display
SJ/T 11281-2017 Test Methods for Light Emitting Diode (LED) Display
SJ/T 11590 Subjective evaluation method of LED display screen image quality
SJ/T 11746-2019 Test Method for Display Performance of Ultra High Definition Television
T/UWA 012.5 Technical Requirements for Public Display System (Outdoor) of the UHD Video and Audio Transmission System for "Bai Cheng Qian Ping"

3 Terms and Definitions

SJ/T 11141, SJ/T 11590, T/UWA 012.5 and the following terms and definitions are applicable to this document.

3.1 Bai Cheng Qian Ping

'Bai Cheng Qian Ping' means 'a hundred cities and a thousand large screens', which is a public promotion project, refers to the 8K UHD HDR image and 3D audio played on over a thousand large screens at commercial streets in more than hundred major cities.

4 Abbreviations

The following abbreviations are applicable to this document.

EOTF: Electro-optical Transfer Function

HDR: High Dynamic Range

LED: Light Emitting Diode

5 Measuring conditions

5.1 Environment conditions

Unless otherwise specified, laboratory tests are conducted under the following standard atmospheric conditions:

—— Ambient temperature: 15 ℃~35 ℃, preferably 25 ℃;

—— Relative humidity: 25% RH~75% RH;

—— Air pressure: 86 kPa~106 kPa;

—— AC power supply: 198V~242V, 49Hz~51Hz or 342V~418V, 49Hz~51Hz.

When arbitration is required, the test shall be conducted under the following conditions:

—— ambient temperature: 23 ℃± 2 ℃

—— Relative humidity: 45% RH~52% RH

—— Air pressure: 86kPa~106kPa;

—— AC power supply: 198V~242V, 49Hz~51Hz or 342V~418V, 49Hz~51Hz.

5.2 Preparation

Unless otherwise specified, preparation conditions are as follows:

a. The environment shall be free of vibration, electromagnetic and photoelectric interference; When interference can affect the test results, it shall be conducted in the test environment specified by the discipline;

b. The display system shall be adjusted to the best display state before the test, and the display system status shall not be changed during the test;

c. The display system should be left in the test environment for 2h, and the preheating time before the test should not be less than 15min;

d. The laboratory test shall be carried out in a dark room, and the stray light intensity on the external surface of the display module shall not be greater than 1 lx.

5.3 Instrument

Unless otherwise specified, the performance of all instruments shall meet the specific measuring requirements.

5.3.1 Signal generator

The signal generator shall be able to generate the test signal required for the measurement.

5.3.2 Luminosity meter

The luminance meter is used to test the brightness of a small area on the screen, with a test range of at least 0.2 cd/m2 to 10000 cd/m2.
The colorimeter shall be able to test the chromaticity coordinates (x, y) or (u',v') of a small area on the screen when the brightness is less than 2 cd/m2. Spectrometric colorimeter is recommended.

5.3.3 **Illuminometer**

The illuminometer requirements are as follows:
——Test range of illuminometer: 0.1 lx ～ 50000 lx;
——Low light level illuminometer: range 10^{-5}lx ～ 1lx;
——Illuminance test accuracy of illuminometer: ± 2% (0.1 lx~10 lx), ± 5% (10 lx~50000 lx);
——Illuminance test accuracy of Microluminance meter: ± 3%.

5.3.4 **Oscilloscope**

The frequency width of the oscilloscope shall not be less than 150MHz.

5.3.5 **Vernier caliper**

The graduation value of vernier caliper shall not be greater than 0.02mm.

5.3.6 **Angle ruler**

The graduation value of the angle ruler shall not be greater than 1°.

5.3.7 **Photoelectric sensor**

The frequency response of the photoelectric sensor is greater than 240Hz.

5.3.8 **AC regulated power supply**

The requirements for AC regulated power supply are as follows:
——Voltage adjustment range: AC 198 V~250 V or AC 342 V~396 V, instability less than 1%;
——Frequency adjustment range: 45 Hz~65 Hz, and the unstable range is ± 1 Hz;
——Harmonic distortion: less than 5%;
——Power requirements: the output power is more than 3 times the rated input power of the equipment to be supplied.

5.4 **Test signal**

5.4.1 **Summary**

The signal shall comply with GY/T 307 and GB/T 41808—2022 , and 3840 × 2160/50/1:1 format signal shall be used for 4K UHD test , 7680 × 4320/50/1:1 format signal for 8K UHD test ,with 10 bit encoding format .

5.4.2 **Color bar signal**

The color bar signal shall comply with the HLG narrow range test chart specified in GY/T 330-2020, as shown in Figure 1, and the composition of the color bar signal test chart is shown in Figure 2.

Figure1 **Schematic diagram of color bar signal**

Figure2 **Composition of color bar signal test chart**

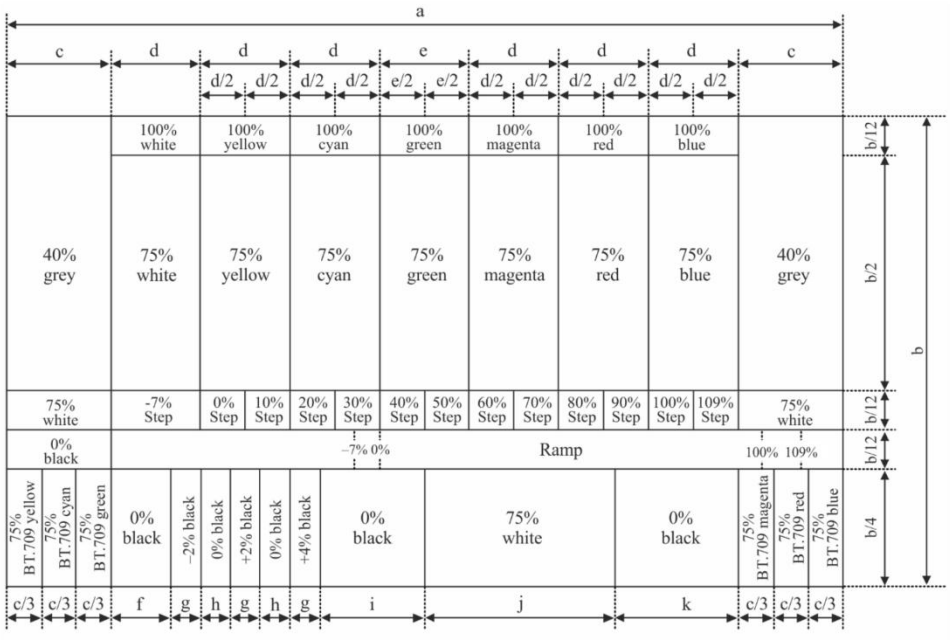


Figure3 **Schematic diagram of full white field signal**

Figure4 **Schematic diagram of all black field signal**

5.4.3 **Full white field signal and full black field signal**

All white field and all black field signals are flat brightness signals with amplitude of 100% and 0% respectively. All white field signals are shown in Figure 3 and all black field signals are shown in Figure 4.

5.4.4 **All red field, all green field and all blue field signals**

Full red field, full green field and full blue field signals are full screen red, full screen green and full screen blue primary color signals with 100% saturation and 100% amplitude respectively, as shown in Figure 5, Figure 6 and Figure 7.

Figure5 **Schematic Diagram of Full Red Field Signal**

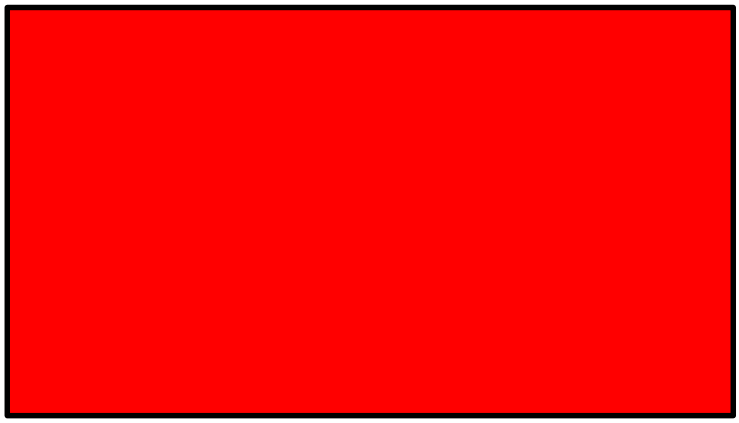


Figure6 **Schematic Diagram of Full Green Field Signal**

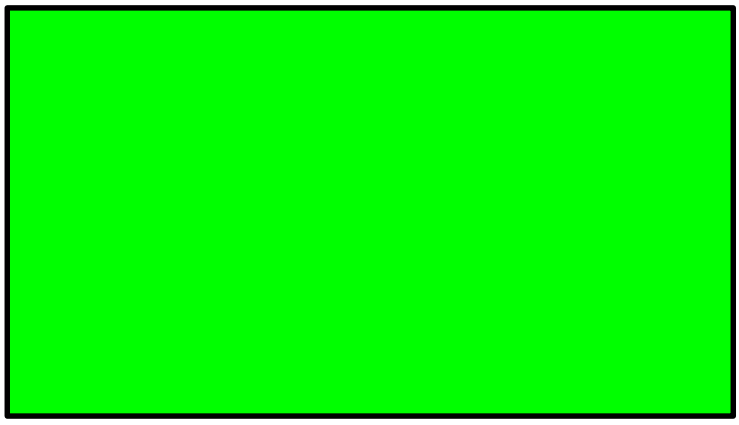
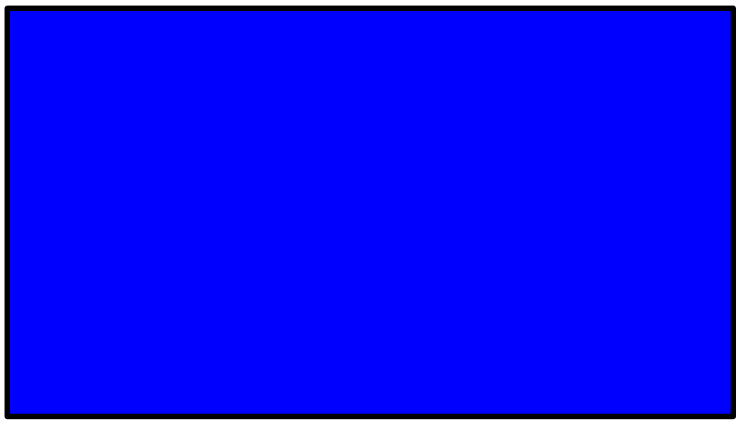


Figure7 **Schematic diagram of all blue field signal**



5.4.5 Chromaticity angle test signal

Nine color signals shown in Table 1 are used. These colors include red, green, blue, yellow, magenta, cyan, dark skin, light skin, and gray.

Table1 **Example of 9 color test signals from chromaticity perspective**

No.	Test signal	Signal level (8bit)			Chromaticity coordinate	
		R	G	B	u'	v'
1	Dark complexion	115	87	74	0.2045	0.4600
2	Light skin	183	145	128	0.2001	0.4502
3	blue	64	69	145	0.1898	0.4271
4	green	76	143	79	0.1457	0.3279
5	red	166	62	68	0.2703	0.6081
6	yellow	214	187	43	0.1880	0.4230
7	Magenta	177	90	143	0.2388	0.5374
8	young	23	130	154	0.1288	0.2897
9	50% grey	121	121	120	0.1846	0.4155

5.4.6 Single pixel signal

The description and example of test chart is in 5.20 of GB/T 26270-2010, as shown in Figure 8 and Figure 9.

Figure 8 **Schematic diagram of single pixel signal**

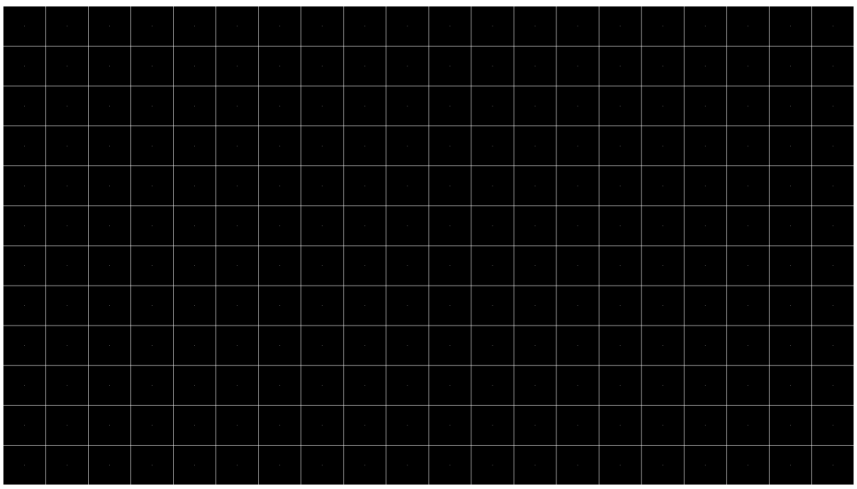
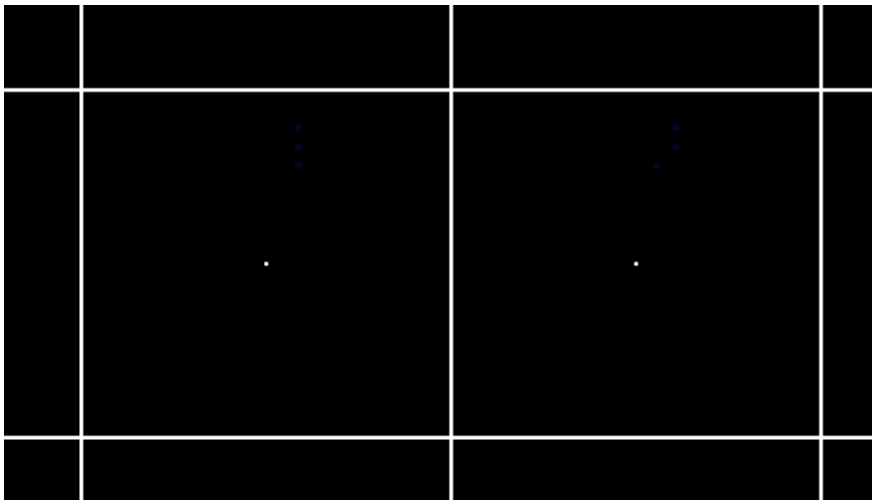


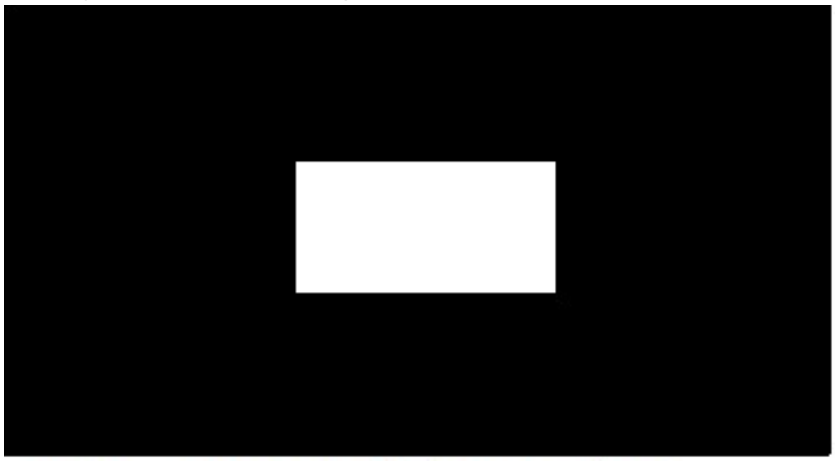
Figure 9 **Schematic Diagram of Partial Enlarged Single Pixel Image**



5.4.7 **10% area white window signal**

10% area white window test chart refers to the white window area accounting for 10% of the total area of the test chart. The schematic diagram is shown in Figure 10.

Figure 10 **Schematic diagram of 10% area white window**



5.5 **Test conditions**

The system contains at least 3 × 3 display modules with splicing area not less than 2m2.
The minimum area luminance on the screen of the luminance meter tests , should include at least 16 adjacent pixels.

6 **Measuring method**

6.1 **Appearance structure**

6.1.1 Visually check the external surface of LED module, the appearance of LED screen, metal parts, and the system surface text identification.

6.1.2 The on-site subjective evaluation method of reflectivity is as follows:

a. In the scene of site environment;

b. Turn off the LED screen light source and observe whether the reflection of each module is consistent;
c. Play the test video and observe whether the pictures displayed by each module are clear and visible.

6.1.3 The interference light shall be tested according to GB/T 34973.

6.2 Broadcast requirements

The broadcast requirements shall be evaluated according to Appendix A.

6.3 Functional inspection

6.3.1 Video input

Input the video signal of the corresponding format to the LED display screen, and observe whether the LED display screen displays the corresponding picture or image normally.

6.3.2 Brightness adjustment

Adjust the brightness of the LED display screen through the control software operation, and check whether there are visible changes with the naked eyes, and the change trend is the same as the brightness adjustment trend.

6.3.3 Color adjustment

Adjust the color of LED display screen through control software, and check whether there are visible changes with the naked eyes, and the change trend is the same as the color adjustment trend.

6.3.4 Adjustable color temperature

Adjust the color temperature of LED display screen through control software, and check whether there are visible changes with the naked eyes, and the change trend is the same as the color temperature adjustment trend.

6.3.5 Signal window opening

Through the control software operation, observe whether the input signal can be displayed in the designated area in the screen display area.

6.3.6 Support HDR conform with GB/T 41808—2022 standard

Input HDR signal conforming to GB/T 41808—2022 standard, and observe whether the signal on LED display screen is normal.

6.3.7 Full screen display

Conduct full screen display operation through control software operation, and observe whether the full screen display operation on LED display screen is successful.

6.3.8 Full screen roaming

Conduct full screen roaming operation through control software operation, and observe whether the full screen roaming operation is successful on the LED display screen.

6.3.9 Window zoom

Observe whether the window on the LED display screen can be enlarged or reduced by operating the control software.

6.3.10 **Window overlay**

Through the control software operation, carry out two or more window superposition operations, and observe whether the window superposition operation on the LED display screen is successful.

6.3.11 **Brightness correction**

Through the control software operation, the brightness of each LED module is corrected to check whether the brightness uniformity of the LED module is improved.

6.3.12 **Chromatic correction**

Conduct chromaticity correction for each LED module through control software operation, and check whether the LED module can improve chromaticity uniformity.

6.3.13 **Smoke and temperature alarm**

Simulate the status of smoke and high temperature, check whether the system can correctly detect smoke and high temperature, send an alarm and automatically turn off the power supply of the display screen.

6.3.14 **Built in underlay**

Through control software operation, set the display content of the underlay, and observe whether the content of the underlay on the LED display screen is displayed normally.

6.3.15 **Redundant backup function**

Set the redundancy backup function through the control software operation, physically cut off the signal source of a single input interface, a single output interface or a single host, and observe whether the screen displayed on the LED screen has completed the backup link switch, without jitter, black field and other abnormalities.

6.3.16 **Visual system of management**

Through the control software operation, the video, audio and environment parts of the LED display system can be visually controlled on a variety of terminal devices. At the same time, the interface style and function buttons can be customized as required, to observe whether the control software can real-time browse the window layout, pre plan layout, audio and surrounding environmental equipment status, and to observe whether the video window opening, plan switching and other operations on the LED display screen are successful.

6.3.17 **Visual system of operation and maintenance**

Through the control software operation, the information of the main components of the LED display system shall be displayed in a visual form. The overall link structure of the system, the static parameter information of the monitoring equipment and the dynamic operation index information shall be displayed. In case of any abnormal fault, the alarm can be given in time.

6.3.18 **Signal pre-monitoring and echo**

Through the control software operation, pre monitor all the signals input into the LED display screen, and echo the information displayed on the screen to the display terminal of the operator.

6.3.19 **Scene setting and patrol**

Through the control software operation, save the window layout and signal source switching on the LED display screen as a scene, set the scene rotation sequence and time interval, and observe whether the scene and scene rotation on the LED display screen switch display normally.

6.4 **Interface inspection**

Use signal source to input signal to LED display system through corresponding interface, and check whether LED display screen can display input content normally.

6.5 **Physical performance**

6.5.1 **Relative deviation of pixel center distance**

The test shall be conducted according to the method specified in 5.1.2.2 of SJ/T 11281-2017.

6.5.2 **horizontal displacement**

The test shall be conducted according to the method specified in 5.1.2.3 of SJ/T 11281-2017.

6.5.3 **Vertical dislocation**

The test shall be conducted according to the method specified in 5.1.2.4 of SJ/T 11281-2017.

6.6 **Display performance**

6.6.1 **Physical resolution**

6.6.1.1 **Test conditions**

Video test signal: single pixel test signal.

6.6.1.2 **Testing procedure**

The test steps are as follows:

a. Display system is in normal working status;
b. Input single pixel test signal and check whether the display system can display normally;
c. Test result is shown as horizontal single pixel lines × Number of vertical single pixel lines.

6.6.2 **Maximum brightness**

The test shall be conducted according to the method specified in 5.2.1 of SJ/T 11281-2017.

6.6.3 **Visual angle**

The test shall be conducted according to the method specified in 5.2.2 of SJ/T 11281-2017.

6.6.4 **Chromaticity angle**

The test shall be conducted according to the method specified in 5.13.2 of SJ/T 11746-2019.

6.6.5 **Contrast ratio**

The test shall be conducted according to the method specified in 5.2.3 of SJ/T 11281-2017, and the normal illuminance of the screen during the test shall be 10 lx (1 ± 10%).

6.6.6 **Brightness uniformity**

6.6.6.1 **Test conditions**

Video test signal: all white field, all red field, all green field, and all blue field test signal.

6.6.6.2 **Testing procedure**

The test steps are as follows:

a. Adjust the LED display system to the highest brightness and gray level;
b. Input the full white field signal to the LED display screen, test the brightness from module 1 to the center point of module n as shown in Figure 11, and record it as L1, L2... Ln;
c. The brightness uniformity of LED display screen shall be calculated by formula (1):

$$L_J = 1 - \frac{|L_i - L_a|_{max}}{L_a} \times 100\% \quad \cdots\cdots (1)$$

Where:

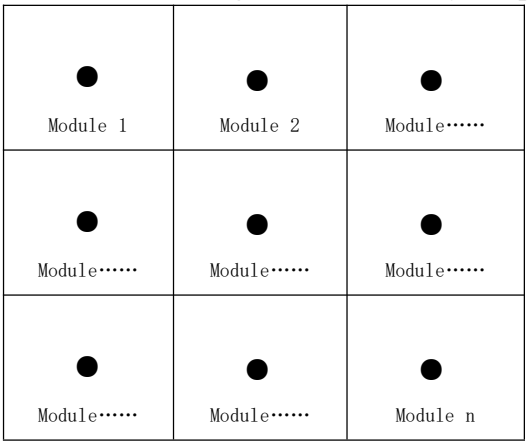
L_J —— brightness uniformity, unit: percentage (%);

Li——The brightness of the center point of each module of LED display screen, in candela per square meter (cd/m2);

La——The average brightness of the center point of each module of LED display screen.

d. Input the full red field, full green field and full blue field to the LED display screen, and repeat steps b) to c);
e. The minimum luminance uniformity of all white fields, all red fields, all green fields and all blue fields is taken as the result.

Figure11 **Schematic diagram of uniformity test points**



6.6.7 **Chromaticity nonuniformity**

6.6.7.1 **Test conditions**

Video test signal: full white field test signal.

6.6.7.2 **Testing procedure**

The test steps are as follows:

a. Adjust the LED display system to the normal working status;

b. Input the full white field signal to the LED display screen, test the chromaticity coordinate value of the center point from module 1 to module n as shown in Figure 11, and record it as;(u'_1, v'_1), (u'_2, v'_2), ...(u'_n, v'_n)

c. The chromaticity nonuniformity of LED display screen shall be calculated by Formula (2), Formula (3) and Formula (4):

$$u'_0 = \frac{u'_1+u'_2+\cdots+u'_n}{n} \quad (2)$$

$$v'_0 = \frac{v'_1+v'_2+\cdots+v'_n}{n} \quad (3)$$

$$\Delta u'v' = \sqrt{(u'_i - u'_0)^2 + (v'_i - v'_0)^2} \quad (4)$$

Where:

u'_0, v'_0——Average value of chromaticity coordinate value of each module center point of LED display screen;

u'_i, v'_i——Chromaticity coordinate value of each module center point of LED display screen;

$\Delta u'v'$——Color unevenness.

d. $\Delta u'v'$The test result is represented by the maximum value.

6.6.8 **Color gamut coverage (BT.2020)**

6.6.8.1 **Test conditions**

Video test signal:

a. Full red field signal;

b. Full green field signal;

c. All blue field signal.

6.6.8.2 **Test steps**

The test steps are as follows:

a. Adjust the LED display system to the normal working state;

b. Display all red field, all green field and all blue field signals respectively, and test the chromaticity coordinates (ur , vr), (u g, v g) and (ub , vb) of the center of the display screen in turn with a colorimeter;

c. Calculate the tricolor gamut area S and gamut coverage GP with Formula (5) and Formula (6):

$$S = \left| \frac{(u'_r - u'_b)(v'_g - v'_b) - (u'_g - u'_b)(v'_r - v'_b)}{2} \right| \quad (5)$$

$$G_p = \frac{S}{0.1118} \times 100\% \quad (6)$$

6.6.9 **Frame frequency**

6.6.9.1 **Test conditions**

Test signal: black field signal diagram, white field signal diagram.

6.6.9.2 **Test steps:**

The test steps are as follows:

a. Set the signal source output to the video format of the nominal resolution and frame rate of the tested equipment;
b. Input the test signal of alternating black field and white field (1 frame of black field and 1 frame of white field), and pick up the optical signal of more than 4 adjacent pixels on the screen with the photoelectric sensor;
c. Observe the screen signal waveform output by the photoelectric sensor with an oscilloscope, test the interval time T between two adjacent images in the signal waveform, and record the frame changing frequency as 1/T.

6.6.10 **Refresh rate**

The test shall be conducted according to the method specified in 5.3.2 of SJ/T 11281-2017.

6.6.11 **Signal processing bits**

The test shall be conducted according to the method specified in 5.3.4 of SJ/T 11281-2017.

6.6.12 **Support signal input**

Input 10bit video signal to LED display system, and check whether LED display screen can display input signal normally.

6.6.13 **Chromatic coordinate deviation**

6.6.13.1 **Test conditions**

Video test signal: full white field.

6.6.13.2 **Testing procedure**

The test steps are as follows:

Method 1:

a. Input the full white field signal, and test the color coordinates u 'and v' of the center point of the display screen respectively;
b. Compare the measured value with the nominal color coordinate of the product, and calculate the respective △ u ′ and △ v ′ with Formula (7) and Formula (8):

$$\Delta u' = u' - u'_0 \quad \cdots\cdots (7)$$

$$\Delta v' = v' - v'_0 \quad \cdots\cdots (8)$$

Where:

⊿ *u*, △ v' —— chromaticity error;

u', v' —— chromaticity coordinate test value;

u0 ', v0' - nominal value of chromaticity coordinate.

Method 2:

a. The input signals are added to the full red field, full green field, full blue field and full white field signals respectively, and the color coordinates u 'and v' of P5 point at the center are tested respectively;
b. Compare the measured values with the BT.2020 color coordinates in Table 2, and calculate their respective △ u ′ and △ v ′ with Formula (7) and Formula (8):

Table2 **BT.2020 Color coordinate value**

colour	u_0'	v_0'
R	0.5566	0.5165
G	0.0556	0.5868
B	0.1593	0.1258
W	0.1978	0.4683

Note: The test is conducted according to method 1, and method 2 is only for reference.

6.6.14 Pixel out of control rate

The test shall be conducted according to the method specified in 5.3.2 of SJ/T 11281-2017.

6.6.15 Non uniformity of black screen

6.6.15.1 Test conditions

The indoor ambient illumination is 200 × (1 ± 10%) lx.

6.6.15.2 Testing procedure

The test steps are as follows:

a. Turn off the power supply of the display screen, and visually select 9 pairs of adjacent areas with the largest deviation within the full screen;
b. Test the brightness values of each module in the 9 pairs of adjacent areas with a luminance meter;
c. Calculate the black screen nonuniformity of each pair of adjacent areas with formula (9);

$$L_i = \frac{\left|L_{i1} - L_{i2}\right|}{(L_{i1}, L_{i2})_{\min}} \times 100\% \quad \cdots\cdots (9)$$

Where:
Li——Non uniformity of each pair of adjacent areas (i=1,2,3... 9);
Li_1——luminance test value of the first display module in each pair of adjacent areas (i=1,2,3... 9), in candela per square meter (cd/m2);
Li_2 ——luminance test value of the second display module in each pair of adjacent areas (i=1,2,3... 9), in candela per square meter (cd/m2).

d. The maximum value is the black screen non-uniformity LB of the display screen.

6.6.16 EOTF curve fit

6.6.16.1 Test conditions

Video test signal: 10% area white window signal. See Table 3 for the example of window brightness assignment.

Table 3 **Example of 10% window signal brightness assignment**

NO.	HLG		
	Full Range	Narrow Range	OETF brightness reference value R at 1000nit peak brightness_ Ln (cd/m2)
1	114	162	1.39
2	176	215	3.9
3	226	266	7.9
4	320	337	16.4
5	453	452	37.9
6	529	517	55.1
7	600	578	79.0
8	652	622	104.2
9	724	684	158.5
10	788	739	232.1
11	849	791	333.9
12	907	841	480.2
13	925	856	536.1
14	965	890	689.1
15	982	905	770.3
16	1023	940	1000.0

6.6.16.2 **Testing procedure**

The test steps are as follows:

a. Input the white window signal in Table 3 in turn, test the brightness of the screen center point and record M_ Ln, complete the test within 1min after switching the signal;
b. Input 100% level white window signal to test the maximum brightness of the screen;
c. Find the test result closest to 60% of the maximum brightness of the receiving device, and record this test result and the corresponding input signal as M_ Lmax and R_ Lmax;
d. Calculate the normalized value using formula (10), where M_ Lmax and R_ Lmax is not calculated, and 15 calculation results are obtained:

$$\mathrm{EOTF\_n} = \log_{R\_Ln/\mathrm{R\_Lmax}} {M\_Ln/\mathrm{M\_Lmax}} \quad \text{.....(10)}$$

e. Calculate the average of 15 EOTF_n calculated results;
f. The test results are expressed as averages.

6.6.17 **Color temperature**

6.6.17.1 **Test conditions**

Video test signal: full white field.

6.6.17.2 Testing procedure

The test steps are as follows:

a. Input full white field signal to LED display screen;
b. Test the color temperature of the center point and record it;
c. Respectively adjust the system color temperature to 3200K, 5000K, 6500K, 7500K, 9300K, and repeat step b.

6.7 Protection grade

According to the test method specified in GB/T 4208.

6.8 Security

According to the test method specified in SJ/T 11141.

6.9 Electromagnetic compatibility

6.9.1 Radio disturbance

According to the test method specified in SJ/T 11141.

6.9.2 Harmonic current

The system harmonic current shall be tested according to the test method specified in GB 17625.1.

6.9.3 Immunity

The system immunity test method shall be in accordance with the test method specified in GB/T 9254.2.

6.10 Environmental adaptability

The system environment adaptability shall be tested according to SJ/T 11141.

6.11 Reliability

6.11.1 Mean Time Between Failures (MTBF)

The mean time between failures of the system shall be tested according to SJ/T 11141.

6.11.2 Support 7 × 24h continuous trouble free operation

The test steps are as follows:

a. Display system runs continuously after 7 × 24h, check whether the display system works normally without fault;
b. After displaying the normal working status of the system, restart the system every 15 minutes for three times in total, and check whether the display system works normally after each startup;
c. When the display system works normally, simulate the failure of the redundant module, and check whether the display system displays normally without affecting the operation.

6.12 Environmental protection

Test according to GB/T 26125.

6.13 Energy saving characteristics

6.13.1 Test method for average efficiency and power factor of power supply

The test steps are as follows:

a. The average efficiency of the system power supply shall be tested according to the method in 5.3.9 of GB/T 14714-2008.

b. When the display screen shows 100% brightness of the full white field, read the value directly from the power meter according to the power factor of the system power supply, and retain three significant number after the decimal point.

6.13.2 Energy efficiency

Calculate energy efficiency with formula (11).

$$Eff = \frac{S \times L}{P_{on} \times \mathrm{n}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (11)$$

Where: Eff ——energy efficiency, in candela per watt (cd/W);

Pon ——Maximum power consumption, in watts (W);

S ——Effective luminous area of display screen, in square meters (m2);

L ——Display screen brightness, in candela per square meter (cd/m2);

N —— constant, 1.7 for black light and 2 for white light.

Note: black light: the LED light emitting tube bracket is black, and the light emitting surface of the light emitting tube is close to the fog black LED light emitting tube under the condition of natural light irradiation.

White light: The LED light emitting tube bracket is white, and the surface is painted with ink on five sides. The light emitting surface of the LED light emitting tube presents white LED light emitting tubes under natural light irradiation.

Appendix A (Normative) Subjective evaluation method for broadcast requirements

A.1 Broadcast requirements Subjective test method

A1.1 Basic viewing conditions

The basic viewing conditions are as follows:

a. Viewing angle: the front position is in front of the display screen, and the side position is within the range of horizontal and vertical nominal viewing angles;
b. Viewing distance: 3 times screen height~10 times screen height is recommended;
c. Viewing environment: outdoor daylight on-site environment.

Note: If the viewing angle and viewing distance cannot be matched at the same time, the viewing angle is preferred.

A1.2 Test materials

3 static pictures with 3840 × 2160 or 7680 ×4320 and 3 dynamic videos with 1min.

A1.3 Watchers

Observers should have normal vision (including corrected vision) and normal color discrimination (no color weakness and color blindness), including 7 to 15 people of different genders and ages.

A1.4 Scoring criteria

Five level subjective image quality evaluation method is adopted, and the scoring criteria are shown in Table A.1.

Table A.1 **Scoring Criteria**

Subjective feeling	Score
Good image quality, very satisfied	5
Good image quality, quite satisfied	4
Average image quality, acceptable	3
Poor image quality, barely accepted	2
The image quality is poor and unacceptable	1

A1.5 Evaluation procedure

The evaluation procedure is as follows:

a. Before the evaluation, the organizer shall introduce the evaluation methods and scoring standards to the evaluation personnel, and conduct evaluation demonstration demonstration;
b. After viewing all the evaluation materials, the evaluators will score item by item;
c. The evaluation organizer shall remove the highest score and the lowest score when calculating the total score, and then take the average score as the final score.

A1.6 Scoring table

Table A.2 is scoring table.

Table A.2 **Scoring Table**

Evaluation	5	4	3	2	1	Describe

items	points	points	points	points	point	
brightness						The brightness is suitable for the scene, no flickering, no dazzling or dim
contrast ratio						Rich image layers and full display of light and dark details
definition						The image outline is sharp and clear, without smear
Color restoration						Various patterns and colors are lifelike, without color bias
Image uniformity						Whether there is mosaic a and dust effect b
Grayscale expressiveness						Each gray-scale image is clearly layered, and whether there is false contour c
Image stability						Whether the image has jitter, fluctuation, bounce, twitch, black screen, etc

a. The display screen has patches of different brightness and color due to inconsistent brightness or chroma or insufficient installation accuracy.

b. Due to uneven light intensity of LED or other reasons, the image quality of the display screen will decline during playback, and the display screen will be covered with a layer of dust visually.

c. Due to insufficient gray level or improper image enhancement and gray level processing of LED display screen, obvious contour lines of equal gray level appear in the image that should be smoothly transited.